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ABSTRACT

This study compared electronic mail, traditional, and combination approaches for teaching graduate introductory statistics classes. The electronic course that was the focus of this study was offered in fall terms of 1995 through 1999. There were 23 participants in the electronic only classes, 69 in the traditional only classes, and 27 in the combination classes, with a majority membership of white females in all classes. Multiple choice pretests and posttests were given. An analysis of covariance (ANCOVA) was run using posttest scores as the response variable and pretest scores as the covariate. Random selection was not possible since participation in any version of the course was optional. Normality and homoscedasticty across all groups were verified. Homogeneity of regression was observed in scatterplots of pretest scores versus posttest scores and their trend lines by treatment and control groups. Therefore, the assumptions required for ANCOVA seemed to be reasonably well met. The test indicated that the null hypothesis of no statistically significant difference among the traditional, electronic, and both traditional and electronic classes' scores could not be rejected at the 0.05 level, with an effect size of f=0, a negligible effect according to J. Cohen. It is concluded that offering the course through electronic mail or a combination of electronic mail and the traditional approach did not appear to hinder the performance of the students, to the extent measured by the multiple-choice tests. Attachments include the ANCOVA report and a course description and syllabus. (Contains 26 references.) (SLD)

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ED 448 192

Basic Statistics via the Internet

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Mid-South Educational Research Association

Twenty-Ninth Annual Meeting

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Bowling Green, Kentucky

November 16, 2000

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Abstract

The study compared electronic mail, traditional, and combination approaches for teaching graduate introductory statistics classes. Approaches presented in the literature recently might be loosely categorized as content/conceptual, use of manipulatives, or use of computer software. The electronic course that is the focus of this study was offered in the 1995-1999 Fall terms. There were 23 participants in the electronic (only) classes, 69 in the traditional (only), and 27 in both groups, with a majority membership of white females. Multiple-choice pretests and posttests were given. An analysis of covariance (ANCOVA) was run using posttest scores as the response variable and pretest scores as the covariate. The ANCOVA technique involves features of both the analysis of variance and regression, so assumptions for both were tested. Random selection was not possible since participation in any version of the course was optional. Normality and homoscedasticity across all groups were verified using the Omnibus Normality of Residuals and Modified-Levene Equal-Variance tests. Homogeneity of regression was observed in scatterplots of pretest scores versus posttest scores and their trend lines, by treatment and control groups. Therefore, the assumptions required for ANCOVA seemed to be reasonably well met. The test indicated that the null hypothesis of no statistically significant difference among the traditional (adjusted mean of 6.82, n=69), electronic (adjusted mean of 7.00, n=23), and both traditional and electronic (adjusted mean of 7.01, n=27) classes' scores could not be rejected at the 0.05 level [$F(2,115)=0.08$, $p=0.92$], with an effect size of $f = 0$, a negligible effect, according to Cohen. It is concluded, then, that offering the course through electronic mail or a combination of electronic mail and the traditional approach did not appear to hinder the performance of the students, to the extent measured by the multiple-choice tests.

There have been a number of approaches presented in the literature recently suggesting methods for teaching statistics at various levels (Becker, 1998; Cobb & Moore, 1997; and Pereira-Mendoza & Schulz, 1997). These approaches might be loosely categorized as content/conceptual, use of manipulatives, or use of computer software.

The content/conceptual approaches have to do with the kind of content that is recommended for a statistics course or the way that the content might be presented. For example, Anderson-Cook (1998) recommended using the design of an experiment, Albert (1997) suggested focusing on data analysis, and Berry (1997), on science applications. Rumsey (1999) recommended the use of cooperative teaching; Schand (1999), game-playing; and Friedman, Halpern, and Salb (1999), humorous anecdotes. Loftsgaarden and Watkins (1998) found in a survey of two-year colleges that among the more common resources used were projects and reports. Schau and Mattern (1997) illustrated the use of conceptual maps to link statistical concepts.

Loosen (1997) described a device that can be used as a teaching aid for instruction in hypothesis testing. The "demonstrator" consists of a wooden frame and wooden representations of sampling distributions with vertical rods to indicate measures of central tendency. The third category includes recommendations for software like DataDesk (Fridlund, 1997) for interactive data exploration, distribution-fitting software (Madgett, 1998), use of the Chance Database (Garfield, 1997) for teaching resources, and computer simulations (Goel, Peruggia, and An, 1997). Ng and Wong (1999) recommended the use of simulation on the internet to teach statistics.

This last category seems to be a growing area. Whereas only a few years ago it was difficult to find any references in the literature to teaching statistics using anything connected with computers, now it is not a difficult task at all (Barker, T. B., 1998; Dokter, C., Hou, K., and Heimann, L., 1998; Keselman, Huberty, Lix, Olejnik, et al, 1998; Madgett, 1998; Morrison and Ross, 1998; Su and Liang, 2000; Yovovich, 1998). What does seem to be lacking, however, is using the electronic mail capability of computers for teaching statistics (McCollum, 1997). It was the purpose of the study, then, to compare electronic mail and a more traditional approach for teaching graduate introductory statistics classes, as well as a combination of the two methods. The electronic course was first offered in the Fall of 1995 with the Fall, 1999, semester being the most recently included (The Fall, 1999, course syllabus is appended.).

The students were allowed to select the delivery type they wanted. All options were available through the same instructor. There were 23 participants in the electronic classes, 69 in the traditional classes, and 27 in both groups, with a diversity of graduate education students, a majority of whom were white females. The students who preferred

the e-mail approach were generally somewhat knowledgeable about the use of computers and modems, but were helped with any difficulties they experienced in communicating this way. Passwords were provided free, as part of student fees, by the academic computing center for students who did not already have their own accounts or who preferred to use a student account. Multiple-choice pretests and posttests were given, developed from standardized tests to insure that there would be variance in the test scores.

An analysis of covariance (ANCOVA) was run using posttest scores as the response variable and pretest scores as the covariate. Since the ANCOVA technique involves features of both the analysis of variance and regression, assumptions for both were tested using the NCSS statistical program, version 6.0.21. The assumption of random selection was not possible since participation in the electronic mail version of the course was optional. However, for a quasi-experimental nonequivalent control group design, Gall, Borg, and Gall (1996) note that the analysis of covariance is frequently used to address the problem of possible pre-existing group differences. Also, there was no obvious demographic difference in the students who chose to take the course electronically and those who opted for the traditional approach, or the combination. Normality and homoscedasticity across all groups were verified using the Omnibus Normality of Residuals and Modified-Levene Equal-Variance tests. Homogeneity of regression slopes was observed in scatterplots of pretest scores versus posttest scores and their trend lines, by treatment and control groups. Therefore, the assumptions required for ANCOVA seemed to be reasonably well met.

The test indicated that the null hypothesis of no statistically significant difference among the traditional (adjusted mean of 6.82, n=69), electronic (adjusted mean of 7.00, n=23), and both traditional and electronic (adjusted mean of 7.01, n=27) classes' scores could not be rejected at the 0.05 level [$F(2,115)=0.08$, $p=0.92$], with an effect size of $f = 0$, a negligible effect, according to Cohen. It is concluded, then, that offering the course through electronic mail or a combination of electronic mail and the traditional approach did not appear to hinder the performance of the students, to the extent measured by the multiple-choice tests. This conclusion is in contrast to the findings of Schutte (cited in McCollum, 1997). However, he concluded that collaboration within groups, rather than teaching using the internet, may have helped students to learn more effectively.

References

Albert, J. (1997, August). Teaching Bayes' rule: A data-oriented approach. The American Statistician, 51(3), 247-253.

Anderson-Cook, C. M. (1998, November). A project for design of experiment courses. The American Statistician, 52(4), 338-342.

Barker, T. B. (1998). Developing courseware for distance learning—any place, any time. In: Distance Learning '98: Proceedings of the 14th annual conference on distance teaching & learning (Madison, WI, August 5-7, 1998).

Becker, W. E. (1998, May). Engaging students in quantitative analysis with short case examples from the academic and popular press. The American Economic Review, 88(2), 480-486.

Berry, D. A. (1997, August). Teaching elementary Bayesian statistics with real applications in science. The American Statistician, 51(3), 241-246.

Cobb, G. W., & Moore, D. S. (1997, November). Mathematics, statistics, and teaching. The American Mathematical Monthly, 104(9), 801-823.

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences, 2nd ed. Hillsdale, NJ: Lawrence Erlbaum, Associates.

Dokter, C., Hou, K., & Heimann, L. (1998). A statistics class website: Distance learning on the Internet. In: SITE 98: Society for Information Technology & Teacher Education 9th International Conference (Washington, D.C., March 10-14, 1998).

Fridlund, A. J. (1997, June 16). DataDesk Plus offers interactive data exploration. InfoWorld, 19(24), 156+.

Friedman, H. H., Halpern, N., & Salb, D. (1999, April). Teaching statistics using humorous anecdotes. The Mathematics Teacher, 92(4), 305-308.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational Research: An Introduction (6th ed.). White Plains, NY: Longman Publishers USA.

Garfield, J. (1997, November). A teacher's review of the Chance Database. The American Statistician, 51(4), 375+.

Goel, P. K., Peruggia, M., & An, B. (1997, May). Computer-aided teaching of probabilistic modeling for biological phenomena. The American Statistician, 51(2), 164-169.

Keselman, H. J., Huberty, C. J., Lix, L. M., Olejnik, S., et. al. (1998, Fall). Statistical practices of educational researchers: An analysis of their ANOVA, MANOVA, and ANCOVA analyses. Review of Educational Research, 68(3), 350-386.

Loftsgaarden, D. O., & Watkins, A. E. (1998, November). Statistics teaching in colleges and universities: Courses, instructors, and degrees in fall 1995. The American Statistician, 52(4), 308-314.

Loosen, F. (1997, May). A concrete strategy for teaching hypothesis testing. The American Statistician, 51(2), 158-163.

Madgett, A. (1998, August). Some uses for distribution-fitting software in teaching statistics. The American Statistician, 52(3), 253-256.

McCollum, K. (1997, February 21). A professor divides his class in two to test value of on-line instruction. The Chronicle of Higher Education, 43(24), A23.

Morrison, G., & Ross, S. (1998, Summer). Evaluating technology-based processes and products. New Directions for Teaching and Learning, (74), 69-77.

Ng, V. M., & Wong, K. Y. (1999, November). Using simulation on the Internet to teach statistics. The Mathematics Teacher, 92(8), 729-733.

Pereira-Mendoza, L., & Schulz, H. (1997, December). Implicit assumptions and communication in statistics. School Science and Mathematics, 97(8), 429-434.

Rumsey, D. J. (1999, November). Cooperative teaching opportunities for introductory statistics teachers. The Mathematics Teacher, 92(8), 734+.

Schau, C., & Mattern, N. (1997, May). Use of map techniques in teaching applied statistics courses. The American Statistician, 51(2), 171-175.

Shand, K. B. (1999, May/June). The numbers game: Teaching kids how to play . . . and win! The Social Studies, 90(3), 121-124.

Su, Y.-T., & Liang, C.-L. (2000, March). Using multivariate rank sum tests to evaluate effectiveness of computer applications in teaching business statistics. Journal of Applied Statistics, 27(3), 337-345.

Yovovich, B. G. (1998, November). Making sense of all he Web's numbers. Editor & Publisher, 30-31.

Analysis of Covariance Report

Page/Date/Time 1 06/01/2000 11:11:03 PM
Database C:\WPDOCS\CONFS\MSERA\Msera00\msera00b.S0
Response Posttest

Expected Mean Squares Section

Source Term	DF	Term Fixed?	Denominator Term	Expected Mean Square
A: Email1No0Both2	2	Yes	S(A)	S+sA
S(A)	115	No		S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

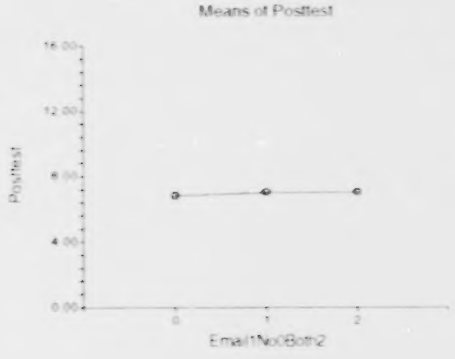
Source Term	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (Alpha=0.05)
X(Pretest)	1	27.54864	27.54864	4.62	0.033626*	0.568440
A: Email1No0Both2	2	1.003387	0.5016935	0.08	0.919300	0.062534
S	115	685.176	5.958052			
Total (Adjusted)	118	716.7899				
Total	119					

* Term significant at alpha = 0.05

Means and Standard Error Section

Term	Count	Mean	Standard Error
All	119	6.945327	
A: Email1No0Both2			
0	69	6.820083	0.2938513
1	23	7.003751	0.5089654
2	27	7.012148	0.4697538

Plots Section



Tukey-Kramer Multiple-Comparison Test

Response: Posttest
Term A: Email1No0Both2

Alpha=0.050 Error Term=S(A) DF=115 MSE=5.958052 Critical Value=3.357981

Group	Count	Mean	Different From Groups
0	69	6.820083	
1	23	7.003751	
2	27	7.012148	

WARNING:
The standard errors of the means do not include
an allowance for the sampling error of the covariate(s).
Hence, any post-hoc tests based on these results are be conservative.

UNIVERSITY OF ARKANSAS AT LITTLE ROCK
College of Education
Department of Educational Leadership
(revised 8/24/99)

I.	Course Prefix and Number	EDFN 7304
II.	Course Title	Basic Statistical Concepts
III.	Credit	3 hours
IV.	Semester and Year	Fall, 1999
V.	Instructor	Rob Kennedy, Ph.D., Professor of Educational Foundations
VI.	Office Location	Larson 204B
VII.	Office Hours	By appointment
VIII.	Telephone	501-xxx-xxxx (UALR), 501-xxx-xxxx (home), rlkennedy@ualr.edu (E-mail)

IX. Course Description

Techniques used in collecting data; graphic presentation of data; logic of inferential testing; t-test and ANOVA; correlation and regression; selected nonparametric procedures.

X. Course Objectives

Given a research problem and data, select an appropriate statistical analysis, conduct the analysis, and interpret the findings.

XI. Texts, Readings, and Instructional Resources

Required Text

Statter, T. M. (1999). Stat Lite. Unpublished.

XII. Assignments, Evaluation Procedures, and Grading Policy

Course Requirements

Mid-term exam (25%)
Participation (25%)
Final exam (50% or 75%)

Evaluation Techniques/Concepts Used for Grading

Grading scale:

A: 90-100
B: 80-89
C: 70-79
D: 60-69
F: 0-59

Mid-term Exam (25%)

The mid-term exam will consist of problems similar to the homework and/or classroom exercises and will be open book and open notes. The content will include the material covered up to that point. Students, including electronic mail students, can choose to take the mid-term test with the rest of the class or take only the final and let it count for 75% of the grade. Note: Although homework and/or classwork will not be collected, the wise student will do the exercises, check the answers, and ask questions when necessary.

Participation (25%)

Please evaluate each chapter in the text. Evaluation forms are included in the book. You can use the same basic form for each chapter.

For each statistical technique there will be an annotated example that will be explained and interpreted in a file on your disk. Your assignment is to produce, for each technique, another annotated example which you will explain and interpret similarly and present in class (traditional class) or submit via electronic mail to EDFN730401 (electronic class). You may use your own data, the data that comes with the NCSS program, or other data available to you (for example, you could generate a database).

On-site students will need to bring enough copies for all class members and the instructor. These reports are necessary so that each person can benefit from the varied examples which are presented.

Final Exam (50 or 75%)

The final exam will consist of two parts, one similar in format to the mid-term, and the other similar in format to the second part of the course. Since the final will thus be comprehensive, covering the content of the entire course, the student may elect to value the test at 75% of the grade if the mid-term score was not as high as desired. In that event, the entire grade other than 25% for participation will come from the final.

XIII. Class Policies

Students who demonstrate dedication to the course through attendance, participation, reading, studying, and otherwise applying themselves to the course will benefit in direct proportion to that effort. In other words, "You get out of it what you put into it." This statement may be a cliche', but the sentiment is not. Practicing with the problems and applications is necessary for developing your skill with, and understanding of, statistics. Just as playing a piano requires much practice to hone ability and interpretation, so does the skill of statistics. If you want to know how and why statistics works, then you need to dig into the subject. Create your own problems and see what happens when various numbers are used or entered. Merely doing the assignments will enable you to get through the course, but true understanding will always require greater commitment. As an advanced student of education, you have to decide if you want to add to your credentials the word "leader".

XIV. Class Schedule

Aug 25/26 Introduction, pretests, overview, picture
Homework: Read Chapters 1-3, work the exercises, evaluate the chapters.

Sep 1/2 Chapters 1-3: Descriptives
Homework: Read Chapters 4-6, work the exercises, evaluate the chapters.

Sep 8/9 Chapters 4-6: Correlation
Homework: Read Chapters 7-9, work the exercises, evaluate the chapters.

Sep 15/16 Chapters 7-9: Regression
Homework: Read Chapters 10-12, work the exercises, evaluate the chapters.

Sep 22/23 Chapters 10-12: T-test
Homework: Read Chapters 13-15, work the exercises, evaluate the chapters.

Sep 29/30 Chapters 13-15: Analysis of variance
Homework: Prepare for mid-term exam.

Oct 6/7 Mid-term exam over Chapters 1-15, evaluation. Turn in chapter evaluation forms if you have not already done so.
Review Chapters 1-6. Run off directions for the descriptives and correlation demo and practice and bring to class next week.

Oct 13/14 Computer Lab. Descriptives and correlation demo and practice
Homework: Prepare for descriptives and correlation presentations.

Oct 20/21 Descriptives and correlation student presentations
Homework: Review Chapters 7-12. Run off directions for the regression and T-test demo and practice and bring to class next week.

Oct 27/28 Computer Lab. Regression and T-test demo and practice
Homework: Prepare for regression and T-test presentations.

Nov 3/4 Regression and T-test student presentations
Homework: Review Chapter 13-15. Run off directions for the analysis of variance demo and practice and bring to class next week.

Nov 10/11 Computer Lab. Analysis of variance demo and practice
Homework: Prepare for analysis of variance presentation.

Nov 17/18 Mid-South Educational Research Association. No class.
Homework: Prepare for analysis of variance presentation.

Nov 24/25 Thanksgiving Holiday. Enjoy!

Dec 2/3 Analysis of variance student presentations.
Homework: Prepare for comprehensive final.

Dec 9/13 Final Exam over Chapters 1-15, posttests, and evaluations.
4:00 - 6:00 p.m. Dec. 9 or 6:00 - 8:00 p.m. Dec. 13.

SPECIAL NOTE ABOUT INDIVIDUAL DIFFERENCES

To insure that we are all aware of individual differences, I wish to cite here from the NCATE accreditation manual:

Cultural Diversity: Cultural diversity refers to the cultural backgrounds of students and school personnel, including their ethnicity, race, religion, class, and sex.

Exceptional Populations: Exceptional populations are comprised of students who possess physical, mental, or emotional exceptionalities which may necessitate special attention by school personnel.

Global Perspective: A global perspective is the recognition of the interdependence of nations and peoples and the interlinking political, economic, and social problems of a transnational and global character.

Multicultural Perspective: A multicultural perspective is a recognition of (1) the social, political, and economic realities that individuals experience in culturally diverse and complex human encounters and (2) the importance of culture, race, sex and gender, ethnicity, religion, socioeconomic status, and exceptionalities in the education process.

The requirements for this class are flexible and designed to accommodate individual differences. All students are evaluated relative to the criteria presented within this syllabus, not relative to other persons. There are no restrictions on the number of A's, B's, or other grades to be awarded. All students who meet the requirements for the class will receive the appropriate grade, regardless of any of the above-noted individual differences.

Source of the above definitions: National Council for Accreditation of Teacher Education. (1990). NCATE standards, procedures, and policies for the accreditation of professional education units. Washington, D.C.: Author, 62-65.

Disabled Student Services

It is the policy of UALR to accommodate students with disabilities, pursuant to federal and state law. Any student with a disability who needs accommodation, for example, in seating, placement, or in arrangements for examinations, should inform the instructor at the beginning of the course. The chair of the department offering this course is also available to assist with accommodations. Students with disabilities are also encouraged to contact the Office of Disability Support Services, which is located in the Donaghey Student Center, Room 103, telephone 569-3143.
Source of the above information: UALR Graduate Bulletin.